ADDENDUM TO THE MEMORANDUM OF UNDERSTANDING

T945-A1

COUPP Muon Veto Detector Calibration and Installation

December, 2005

INTRODUCTION

This Addendum to the T945 Memorandum of Understanding describes a scintillating muon veto detector system that will be added to the COUPP bubble chamber in the MINOS near hall and use of beam time at Fermilab during the Winter 2005- 2006 Meson Test Run to plateau these muon veto counters.

This is a memorandum of understanding between FNAL and the experimenters in COUPP. This memorandum is intended solely for the purpose of providing a work allocation for FNAL and the experimenters. It reflects an arrangement that is currently satisfactory to the parties involved. It is recognized, however, that changing circumstances of the evolving research program may necessitate revisions. The parties agree to negotiate amendments to this memorandum to reflect such revisions.

COUPP is a detector test of a bubble chamber that is sensitive only to nuclear recoils, thus making an ideal dark matter detector. It operates under the T945 test beam designation and is currently running in the MINOS near hall onsite at Fermilab. The experimenters believe that the ultimate limitation for rate in this bubble chamber is due to neutrons generated from cosmic ray interactions. Other dark matter experiments have found that it is necessary to veto the cosmic ray muon flux that remains after filtering through the rock overburden. The COUPP detector would like to implement such a muon veto shield in its current configuration.

The experimenters have found an adequate supply of scintillators in the KTEV experiment onsite at Fermilab. The experimenters will use about 150 of the hodoscopes that were used as the muon system in KTEV. These scintillators are 15 cm x 150 cm. Figure 1 shows how these scintillators would form a cage around the COUPP bubble chamber. There are two layers in each side, to form coincidences, and the two layers are separated by high density polyethylene to absorb the gammas prevalent in the MINOS hall. The PMT's will be powered by a LRS 1440 high voltage system (which requires a 208V outlet in the MINOS hall) and will be read out by a combination of CAMAC and NIM electronics, outlined in Appendix I.

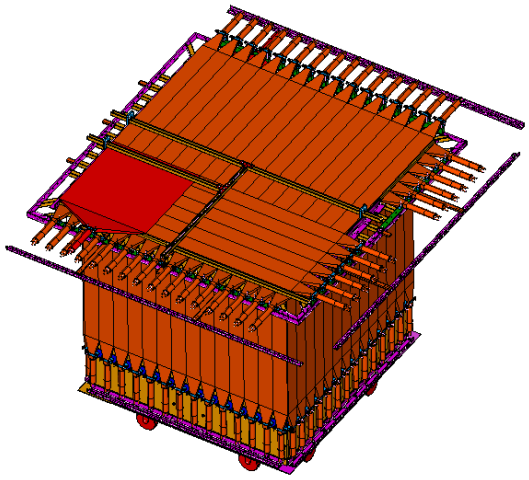

Figure 1. View of muon veto cage around COUPP bubble chamber.

To ensure that these hodoscopes are efficient for muon vetoing and also to ensure that their accidental veto rate is small enough not to affect the experiment's live time, it is crucial to set the high voltage on the PMT's for these counters just above their plateau point. The experimenters thus plan on beam time in the Meson Test Beam line to determine this plateau point for all counters. The experimenters will align 9 counters at a time in the downstream MT6 beam enclosure. Each slow spill will give enough rate to make one voltage measurement for these 9 counters. About 20 measurements need to be made (30 volt steps from 1500 to 2100 V). Each spill takes 2 minutes, thus 9 counters can be plateaued in 40 minutes, or the whole set of 150 in about 24 hours (taking into account accesses to change over counters). Depending on beam conditions, the experimenters can run simultaneously with other test beam groups.

The experimenters are building the L-shaped side support structures and top lattice structure in lab 8. The experimetners will verify that the counters will fit and then will lower them into the MINOS hall down the access shaft. Any counters not attached to the support structures will be brought down in the elevator and assembled onto the support structure at the COUPP site.

I. PERSONNEL AND INSTITUTIONS:

Spokesman and
physicist in charge of beam tests: Erik Ramberg

The group members at present are all Fermilab employees:
Mike Crisler, Andrew Sonnenschein, Hogan Nguyen, Todd Nebel

II. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS

2.1 LOCATION

2.1.1 The muon veto system frame will be built and initially tested at lab 8 and then lowered into the MINOS near hall, at which time any scintillators that haven't been put on will be attached.

2.1.1 The plateauing of the muon counters is to take place in the MTest beam line and located in the area designated MT6-B4. In addition, the main control room to the west of the MTest line will be used to house electronics (one NIM bin, one CAMAC, our computer, and scope), and provide a small amount of work space (for 2 people).

2.2 BEAM

2.2.1 The plateauing tests will use slow resonantly-extracted, Main Injector proton beam focused onto the MTest target. The tests require a beam of untagged, charged particles of any momentum above 16 GeV.

2.1.2 Intensity: In the range of 5 KHz in an area of a square cm or so.

2.3 SETUP

The setup in the MTest beamline will be a unistrut table on a die cart. Wooden holders will hold the hodoscopes to be tested. (The wood will be painted with non-flammable paint.) The experimenters will connect the HV cables for the counters from the beamline to the main control room, where the experimtners will control the HV settings. The signal cables will also come into the main control room so that the experimenters can measure rates.

2.4 SCHEDULE

Since the experimenters have already used the table and holders in measurements downstream of the MT6 beamstop, everything is essentially ready to go. The experimenters can move into the beamline at any time and immediately begin taking data. The experimenters will probably take data 8 hours per day for about 3 days, with two people manning each shift. The experimenters will be able to take data simultaneously with other groups.

III. RESPONSIBILITIES BY INSTITUTION - NON FERMILAB

3.1 There are no non-Fermilab members in this group.

IV. RESPONSIBILITIES BY INSTITUTION - FERMILAB

4.1 **Fermilab Accelerator Division:**

4.1.1 Use of MTest beam.
4.1.2 Maintainence of all existing standard beam line elements (SWICs, loss monitors, etc) instrumentation, controls, clock distribution, and power supplies.
4.1.3 Reasonable access to the experimenters' equipment in the test beam.
4.1.4 The test beam energy and beam line elements will be under the control of the BD Operations Department Main Control Room (MCR).
4.1.5 Position and focus of the beam on the experimental devices under test will be under control of MCR. Control of secondary devices that provide these functions may be delegated to the experimenters as long as it does not violate the Shielding Assessment or provide potential for significant equipment damage.
4.1.6 The integrated effect of running this and other SY120 beams will not reduce the antiproton stacking rate or protons on target for the neutrino program by more than 5% globally, with the details of scheduling to be worked out between the experimenters and the Office of Program Planning.
4.1.S Summary of Beam Division costs:

Type of Funds	Equipment	Operating	Personnel (person-weeks)
Total new items	$0.0K	$0K	0.0

4.2 Fermilab Particle Physics Division

All material purchases will be paid for with T945 funds already allocated.

4.2.1 The test-beam efforts in this MOU will make use of the Meson Test Beam Facility. Requirements for the beam and user facilities are given in Section 2. The Fermilab Particle Physics Division will be responsible for coordinating overall activities in the MTest beam-line, including use of the user beam-line controls, readout of the beam-line detectors, and MTest gateway computer. (2 person weeks)
4.2.2 Assistance in moving KTEV muon counters to Meson Test Beam area. (1 person week)
4.2.3 Assistance in constructing muon veto support structure. (1 person-month) [$10K]
4.2.4 Assistance in lowering muon veto support system into the MINOS near hall. The experimenters will generate a work hazard analysis (WHA) for this task.

4.2.5 Installation of 208V circuit in MINOS hall. [$1.5K]

4.2.6 The experimenters require one NIM bin and two CAMAC crates for the project, as well as various PREP modules. The list of electronic modules needed is given in Appendix 1.

4.2.S Summary of Particle Physics Division costs:

Type of Funds	Equipment	Operating	Personnel (person-weeks)
Total new items	$11.5K	$0K	7

4.3 Fermilab Computing Division

4.3.1 No support from the computing division is needed for the muon veto addition.

4.4 Fermilab ES&H Section

4.4.1 The experimenters will require assistance with safety reviews.

V. SUMMARY OF COSTS

Source of Funds [$K]	**Equipment**	**Operating**	**Personnel** (person-weeks)
Accelerator Division	$0K	$0K	0
Particle Physics Division	$11.5K	0	7
Computing Division	0	0	0
Totals Fermilab	$11.5K	0	7

VI. SPECIAL CONSIDERATIONS

6.1 The responsibilities of the spokesman of the COUPP veto group and the procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Experimenters" (http://www.fnal.gov/directorate/documents/index.html).. The Physicist in charge agrees to those responsibilities and to follow the described procedures.

6.2 To carry out the experiment a number of Environmental, Safety and Health (ES&H) reviews are necessary. This includes creating a Partial Operational Readiness Clearance document in conjunction with the standing Particle Physics Division committee. The spokesman of the COUPP veto group will follow those procedures in a timely manner, as well as any other requirements put forth by the division's safety officer.

6.3 The spokesman of the COUPP veto group will ensure that at least one person is present at the Meson Test Beam Facility whenever beam is delivered and that this person is knowledgeable about the experiment's hazards.

6.4 All regulations concerning radioactive sources will be followed. No radioactive sources will be carried onto the site or moved without the approval of the Fermilab ES&H section.

6.5 All items in the Fermilab Policy on Computing will be followed by the experimenters. (http://computing.fnal.gov/cd/policy/cpolicy.pdf).

6.6 The spokesman of the COUPP veto group will undertake to ensure that no PREP or computing equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the Computing Division management. The spokesman will also undertake to ensure that no modifications of PREP equipment take place without the knowledge and consent of the Computing Division management.

6.7 The COUPP veto group will be responsible for maintaining and repairing both the electronics and the computing hardware supplied by them for the experiment. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.

6.8 At the completion of the experiment:

6.8.1 The spokesman of the COUPP veto group is responsible for the return of all PREP equipment, computing equipment and non-PREP data acquisition electronics. If the return is not completed after a period of one year after the end of running the spokesman of the Iowa group will be required to furnish, in writing, an explanation for any non-return.

6.8.2 The experimenters agree to remove their experimental equipment as the Laboratory requests them to. They agree to remove it expeditiously and in compliance with all ES&H requirements, including those related to transportation. All the expenses and personnel for the removal will be borne by the experimenters.

6.8.3 The experimenters will assist the Fermilab Divisions and Sections with the disposition of any articles left in the offices they occupied, including computer printout and magnetic tapes.

6.8.4 An experimenter will be available to report on the test beam effort at a Fermilab All Experimenters Meeting.

SIGNATURES:

_____ / / 2006
Erik Ramberg, Fermilab

_____ / / 2006
Greg Bock, Particle Physics Division

_____ / / 2006
Roger Dixon, Accelerator Division

_____ / / 2006
Robert Tschirhart, Computing Division

_____ / / 2006
William Griffing, ES&H Section

_____ / /2006
Hugh Montgomery, Associate Director, Fermilab

_____ / /2006
Steven Holmes, Associate Director, Fermilab

APPENDIX I – COUPP MUON VETO **– EQUIPMENT POOL NEEDS**

PREP Equipment Pool needed for Fermilab test beam on the first day of setup. Items with an asterisk (*) indicate equipment in hand.

Quantity	Description
1	NIM crate, with cooling fans *
2	CAMAC crate and power supply
12	LRS 4413 discriminators *
2	Phillips 710 discriminators *
2	Phillips 752 coincidence units *
2	LRS 429 logic fan in/fan outs *
1	LRS 222 gate generator *
1	LRS 1449 main frame *
1	LRS 1441/1442/1445 HV controllers/supplies *
1	LRS 1447 handheld TTY
1	LRS 2132 CAMAC interface
10	LRS1443 HV cards

APPENDIX II - Hazard Identification Checklist

Items for which there is anticipated need have been checked

Cryogenics		Electrical Equipment		Hazardous/Toxic Materials	
	Beam line magnets		Cryo/Electrical devices		List hazardous/toxic materials
	Analysis magnets		Capacitor banks		planned for use in a beam line or experimental enclosure:
	Target	**X**	high voltage (150 channels supplied by LRS 1440 system		
	Bubble chamber		exposed equipment over 50 V		
Pressure Vessels		**Flammable Gases or Liquids**			
	inside diameter	Type:			
	operating pressure	Flow rate:			
	window material	Capacity:			
	window thickness	**Radioactive Sources**			
Vacuum Vessels			permanent installation	**Target Materials**	
	inside diameter		temporary use		Beryllium (Be)
	operating pressure	Type:			Lithium (Li)
	window material	Strength:			Mercury (Hg)
	window thickness	**Hazardous Chemicals**			Lead (Pb)
Lasers			Cyanide plating materials		Tungsten (W)
	Permanent installation		Scintillation Oil		Uranium (U)
	Temporary installation		PCBs		Other : **Iron (Fe), Ta Cu**
	Calibration		Methane	**Mechanical Structures**	
	Alignment		TMAE		Lifting devices
type:			TEA		Motion controllers
Wattage:			photographic developers	X	scaffolding/elevated platforms
class:			Other: Activated Water?		Others